

B.E. ELECTRICAL ENGINEERING 2ND YEAR 1ST SEMESTER EXAMINATION, 2023**SUBJECT: - ELECTRICAL MEASUREMENTS & MEASURING INSTRUMENTS****Time: Three hours****Full Marks 100
(50 marks for each part)****Use a separate Answer-Script for each part****PART-I****Answer any 2 (25X2=50)**

1. Justify and correct (if required) the following statements (any five): (5X5=25)
 - a) "Phantom Loading" saves power loss by wattmeter during calibration of the wattmeter by dc potentiometer.
 - b) Interbridge transformers are used for electrical isolation in AC bridges.
 - c) Scale of the Megger is cramped towards the higher values of resistance.
 - d) The two measured values of resistance of the insulation are different in Price's Guard wire method when readings are taken with both forward and reversed polarities of the battery.
 - e) High Voltage Schering bridge requires some safety measures for operating personnel.
 - f) A thick metal link in Kelvin's Double bridge reduces measurement error.

2.
 - a) What is the use of guard wires in high resistance measurement? Explain with a measuring circuit diagram. 4
 - b) How can you devise a measurement setup to obtain the B-H loop of a specimen of magnetic material using Ballistic galvanometer? Explain the method for obtaining the B-H loop using the setup. 10
 - c) In magnetic loss test of a specimen of total weight 5 kg the measured values of iron loss at a given peak flux density were 40 watt at 45 Hz and 70 watt at 55 Hz. Estimate hysteresis and eddy current losses in Watt/kg at 50 Hz for the same peak flux. 5
 - d) Derive the condition for maximum sensitivity of Wheatstone bridge based resistance measurement. 6

3.
 - a) Define *gauge factor* and *transverse sensitivity* of a strain gauge. 2
 - b) What are the properties of good strain gauge material? Comment on relative merits and demerits of semiconductor strain gauges over metal strain gauges. 3+3
 - c) You are asked to generate an electrical signal, some parameter of which is proportional to the temperature of an oil tank. Draw a schematic (circuit diagram) that can be used for this purpose. 4
 - d) Derive the expression of measurement sensitivity for a Wheatstone bridge method based strain measurement with one active and one dummy gauges. 8
 - e) The four arms of an AC bridge at balance are: arm AB an unknown inductance L_1 having a resistance R_1 ; arm BC a non-inductive resistance of 1000Ω ; arm CD a capacitance of $0.25\mu\text{F}$ in parallel with a resistance 1000Ω ; arm DA a resistance of 1000Ω . The source is connected to A and C and the detector is connected between B and D. Derive the equations for balance and find the values of R_1 and L_1 . 5

[Turn over

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4. Write notes on *any two* (12.5 X2
=25)
- a) Separation of iron loss components of a specimen of magnetic material using Lloyd Fisher Square
 - b) Standardization of laboratory type DC potentiometer
 - c) Cold junction compensation of thermocouples
 - d) Loss angle measurement of a Capacitor using Schering Bridge

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No. of Questions	PART- II	Marks
	<p><i>Answer question as per the directives associated with each group.</i></p> <p>GROUP-A <i>[Answer any three from question-1 and any two from question-2]</i></p> <p>1. Comment clearly whether the following statements are true or false. Justify in favour of your comment.</p> <p>a) "Temperature compensation of the pressure coil is not necessary because of its inherent resistance of high value."</p> <p>b) "The amplitude of oscillation of a Duddell's vibration galvanometer is enhanced by varying the length between bridge pieces."</p> <p>c) "Self-inductance of the coil of moving iron instrument varies with time during its transient state."</p> <p>d) "Universal shunt is used to attain steady state deflection at high current."</p> <p>e) "When signals of different frequencies are applied to the two coils of electro-dynamometer, its deflection becomes zero."</p> <p>2. Compare:</p> <p>i) Swamping resistance and shunt resistance</p> <p>ii) Spring controlled and gravity controlled system</p> <p>iii) Electromagnetic damping and eddy current damping</p> <p>GROUP-B <i>[Answer any one from the following questions]</i></p> <p>3. Describe with the help of appropriate diagram the principle of generation of deflecting torque in a moving iron instrument.</p> <p>4. Explain in brief how the PMMC rectifier type instrument can be used to measure AC and DC quantities with two different scales.</p>	<p>3x3=9</p> <p>2x3=6</p> <p>7</p>

GROUP-C [Answer any four from question no. 5]

5.

4x5=20

a) A wattmeter with resistance of the two coils as 0.01 ohm and 1000 ohm, respectively, is used to measure the power supplied to an inductive load of power factor 0.7. The load current and load voltage during measurement are 20A and 30V, respectively. Which type of connection will you recommend for the measurement of power, and why?

b) A Current Transformer with primary turns of 5 has secondary burden consisting of a resistance of 0.16 ohm and an inductive reactance of 0.12 ohm. When the primary current is 200A, the magnetizing current is 1.5A and the loss component of current is 0.4A. Determine the number of secondary turns needed to make the current ratio 100:1. Find the corresponding phase angle under these conditions.

c) Current coil and pressure coil of an electro-dynamometer are placed in a circuit, as shown below in Fig-A.

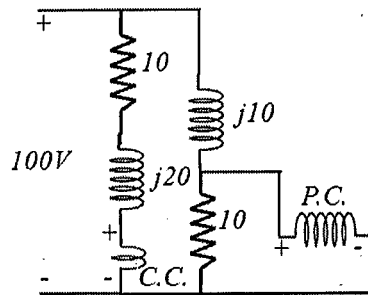


Fig-A.

What will the wattmeter read?

d) In reference to Fig-B, three resistances of 200, 400 and 500 ohm are connected in series. A voltmeter of resistance 10K, when connected across 500 ohm reads 100V.

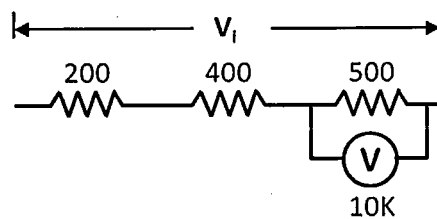


Fig-B.

What will be the reading of the voltmeter when its internal resistance is increased to 20K?

	<p>e) An electro-dynamometer wattmeter is used to measure power in a single phase circuit. The load voltage and load current are 110V and 8A, respectively. The pressure coil circuit has a resistance of $5K\Omega$ and an inductance of 40mH. Estimate the percentage error in the reading of wattmeter. The operating frequency is 50Hz.</p> <p>GROUP-D [<i>Answer any four from the question no. 6</i>]</p> <p>6. a) What is the purpose of using compensating winding in a certain type of wattmeter?</p> <p>b) What happens if a steady charge is allowed to pass through a Ballistic Galvanometer?</p> <p>c) What happens if the secondary of a current transformer is open-circuited?</p> <p>d) If the material used in making former of an indicating instrument is changed from aluminium to wood, what will be the effect of such change upon the magnitude of electromagnetic damping and eddy current damping?</p> <p>e) How do you make the performance of a shunt free from the error of frequency variation?</p> <p>f) What is the current sensitivity of a D'Arsonval galvanometer?</p>	4x2=8
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